The Science of **Kitchen**

Science around us series, booklet - II

The Science in the KITCHEN

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The Science in the Kitchen

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FOREWORD

The young mind is ever inquisitive, sometimes they ask questions which is difficult to find within the limitation of the text books. This series deal with such questions emerging out of the garden and kitchen and other places; describe the amazing achievements in the field of S&T communication; describes the alternatives to the danger of chemicals that we use daily.

National Council for Science and Technology Communication (NCSTC) is an apex body set up with the objectives of communicating science and technology, stimulating scientific temper and developing scientific capability amongst the people has collaborated with Development Research Communication and Services Centre (DRCSC), Kolkata, which is devoted to spreading and popularizing environment science amongst people for last 25 years to bring out this series to demystify scientific phenomenon of science in daily life for the children. Hope the grown up will enjoy it too.

We trust that this will encourage the children to search for larger picture, dig deep in to the mysteries of science & successes of technology and of course sustainable living alternatives.

Dr. D.K. Pandey

Scientist 'E'

EPS
sprite
thum Up
thum Up

Chapter 1 What is food

"Not again!!",!" Munni made a face at her well packed tiffin-box. Ma has given her boiled egg and banana again . Sayra looked disappointed too. She had Chhapati-sabji and a guava. Quickly they counted their pocket money and bought a packet of Potato Chips and a bottle of soft drinks. Yummy!! Far better than a guava or a banana!

In the evening, Munni earned an egg-roll and a chilled bottle of soft drink after a long fight with Papa. Papa was angry and was trying to explain the bad effects of fast food to Munni, but finally gave up .

Up in the morning, Papa showed Munni some news clippings:

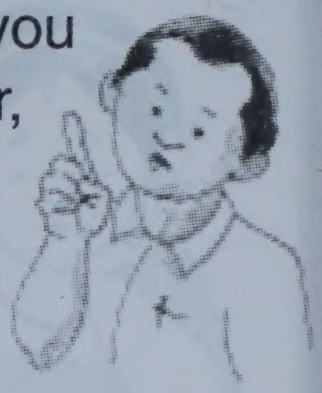
Junk Food in School

...When given a choice of high-fat or high-sugar food, such as fries and soft drinks, children seldom choose healthier fare. That's why nutrition scientists recommend that schools should serve the healthy food and must eliminate junk food from school vending machines...

Fast Food and Children

...Some reports show that the number of overweight children in the age group 6 to 11 has doubled from 7% to 13% in the past 25 years. They add that even school principals are encouraging the sale of soda pop and other junk food. It is also alarming that our children are continuously being bombarded with fast food ads, anywhere they go, at any time of the day. The studies also reveal that 40% of our children get their food from fast food chains, convenience stores and restaurants...

"What does it all mean Papa?", Munni asked.



"Can't you remember what I was trying to tell you last evening?" Papa said. "If not, ask your mother, I am running late for office. Just remember that healthy people generally have a lower risk of getting heart disease or cancer. And to stay healthy, you must eat healthy."

Munni didn't understand anything. She peeped into the kitchen. Ma was preparing chapaati.

"Ma, what was all that Papa was saying? I didn't understand anything."

"Haven't you read in the biology book about the different categories of food that we require?" - replied Ma.

"Yes Ma. Carbohydrate, Protein, Fat, Vitamins and Minerals" - Munni quoted from the book.

"Do you know why we need all these?"

"Yes Ma, here is a Pie Chart"- Munni shows her book.

Whole body : a mass of thousands of chemical substances, in different combinations and proportions

Water : makes up about two-thirds of the entire body. The chemical reactions of life happen between substances dissolved in water

Proteins : the body's main structural molecules, forming a living framework in and around cells. They are plentiful in foods such as meat, fish and cheese

Carbohydrates : have mainly energy-providing functions in the body. They are absundant in sweet or starchy foods such as flour, bread, rice and sugar

Minerals : have many specialized roles in body chemistry. Body minerals include copper (as in hot-water pipes), iron (as in nails), sulpher (as in Match heads), and trace elements such

Lipids (fats and oils): make up the thin microscopic sheets, known as membranes that form the outer "skin" of each cell and most organelles. They are similar to the fats and oils used for cooking and those in butter

"That is all written in your book. But how much do you really follow ?"

"Why Ma, I have studied all of these for my exams."

"Munni, books are not written only for exams. They're written so that you apply the knowledge in your own life." Ma said while chopping up a potato.

" What do you think this potato has?"

Water is not counted as food. But we require water all the time. Why? Water accounts for about 55 to 68 percent of the total adult body weight. Overall, water is an universal solvent, is *responsible for movement of food* from mouth to the stomach, and is able to *dissolve most of the products of digestion.* Our *blood contains* 90 percent *water.* Water flows in and out of the cells and around the body. When water levels fall, the concentration of various substances in the blood rises, and this is the reason we all feel thirsty.

"I know Ma, carbohydrate"

"If we fry it with oil, some fat is added. If you take only fried potato, how would your body get the nutrition of other food groups that you have shown me just now? From where would the immunity come? Which food will build your body? Where will you get all those important vitamins and minerals from?"

Munni stared back guiltily, remembering all the junk food she had in the last week or so.

"And water. Though water is not food, but we need it in large amount. But you never bother to drink sufficient water!"

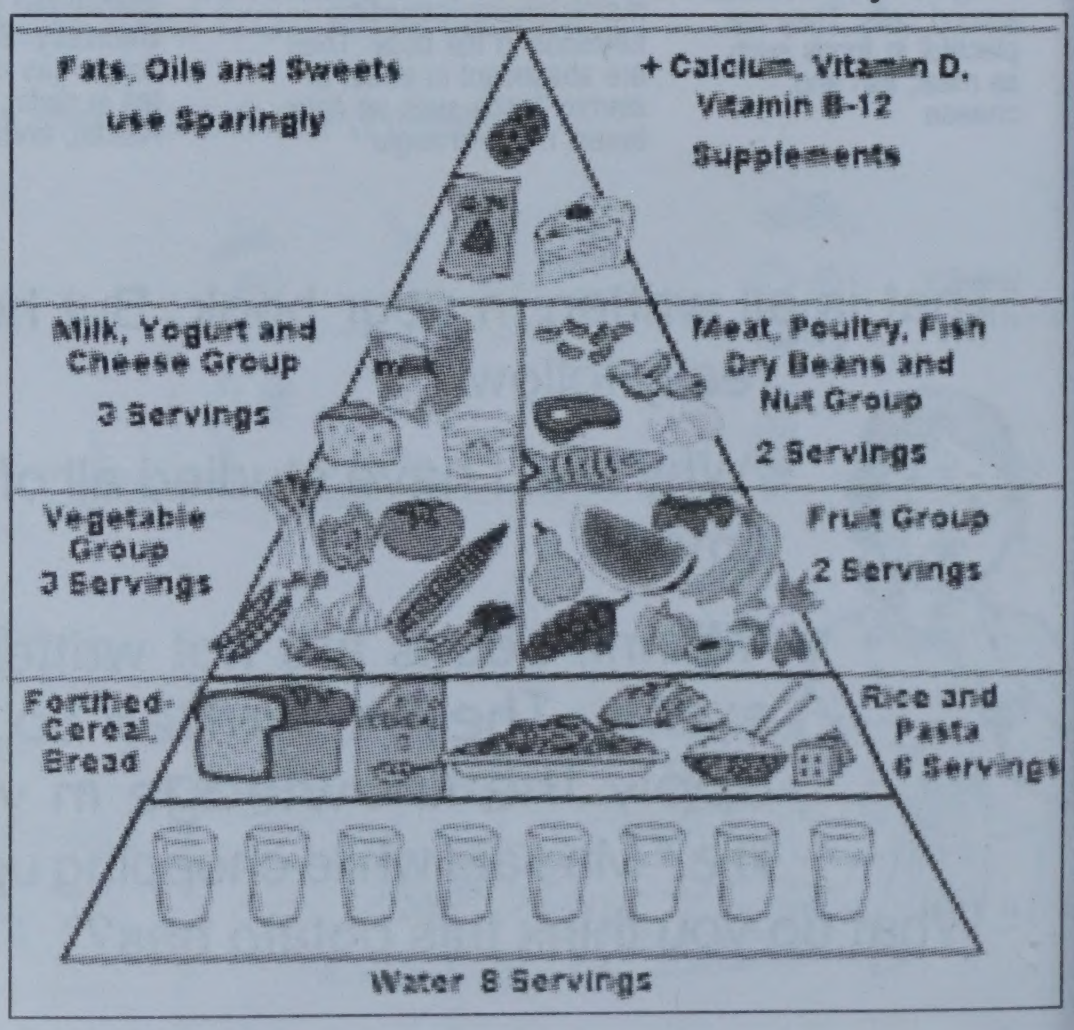
"Oh boy! I'll surely drink enough water henceforth."

Now she picked up a potato chip and asked " Ma, why do you add salt to the potato and sun-dry it before you fry?"

"Well, to answer this, let us do an activity. We will observe the result when you comeback from the school."

Food Pyramid

- food to be consumed in a day



Do it yourself

Things required

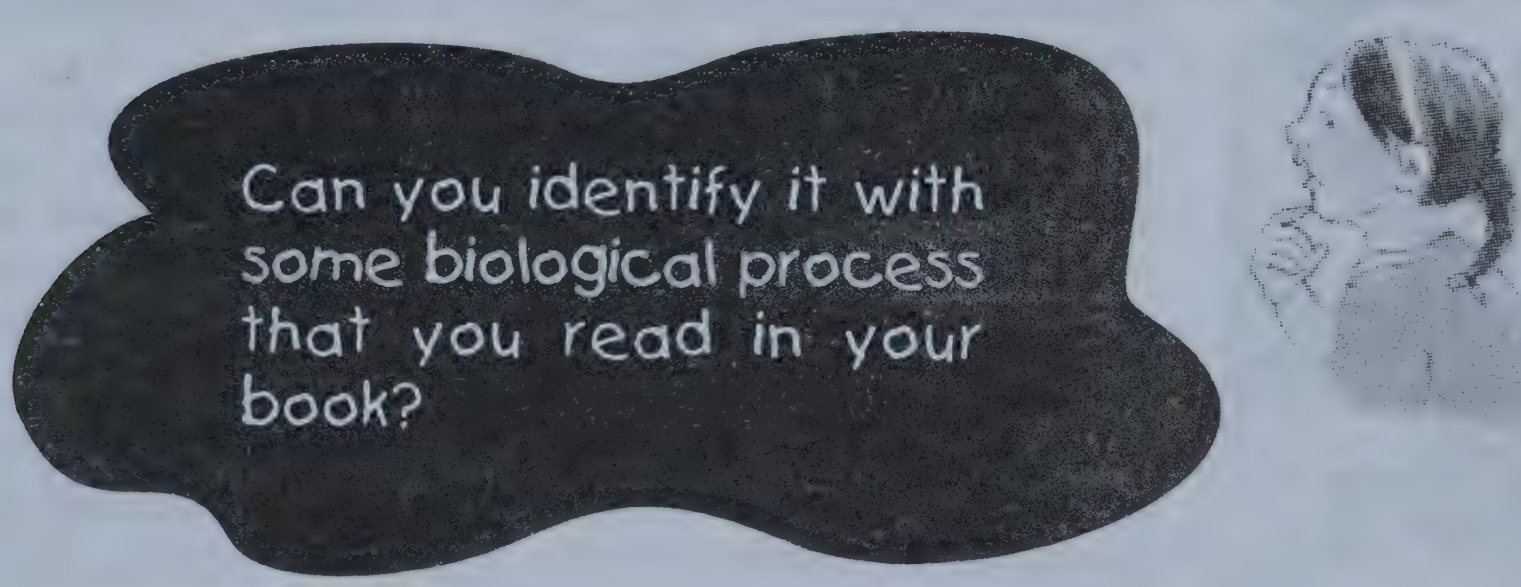
10-12 raisins, grapes, water, sugar syrup or honey

Method

- Place 5-6 raisins in water.
- Within an hour, you will notice that the raisins have begun to swell. Their wrinkled surface has become even and distended.
- If kept for a longer time, the outer coat of the raisins bursts at some point, as though it is over inflated.
- Next, try putting the remaining raisins in thick sugar syrup of honey.
- Similarly, try putting fresh grapes in thick sugar syrup. The shrink in the raisins would prove that something has flown out.

You know the answer to Munni's question now.

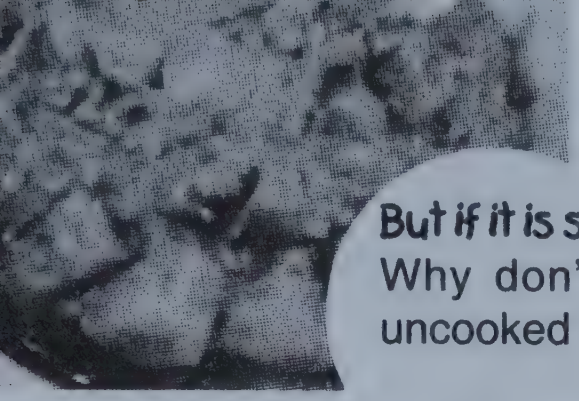
If you add salt, all the water will come out of the pieces of potato. Sun light will let that water evaporate. And when you fry, it will be crispy!



Here we are giving a summary of the question and answer session that Munni had with her mother.

Why do we eat?

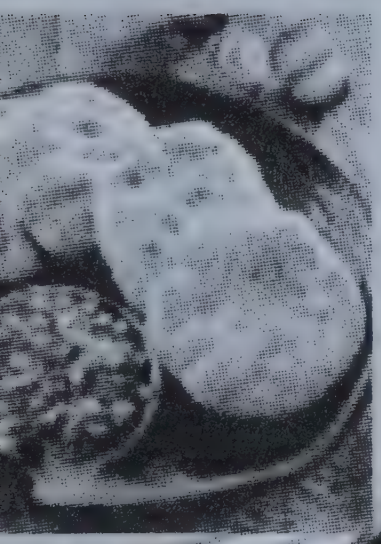
Simple, because we are hungry!! Why are we hungry? Because our stomach becomes empty! Why does our stomach get empty? Because we digest all the food! But after digesting, what? Is it the only purpose of having a roasted chicken? Just to satisfy our taste buds and stomach? Well, scientists say food helps in the building of the body, provides energy, and regulates the activities of the body.



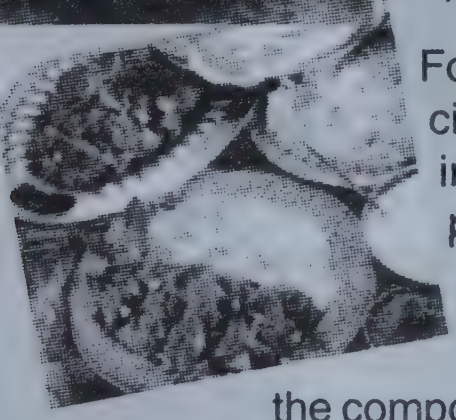
But if it is so, Why do we cook?
Why don't we just munch some daal, eat raw fish and uncooked rice without wasting much time and energy.

We cook different foods in different manner for the following reasons:

- To make chewing and digestibility easy: Our intestine can only absorb very simple form of food- simple in size and chemical composition.Chewing is also a part of digestion, which helps the food to be swallowed through throat. Cooking helps teeth to chew easily. Cooking involves heating and adding chemicals, which breaks down larger nutrient molecules to smaller one, making the work of intestine easy.
- Improves the taste and food quality: You can have *khichdi* with daal and rice! But adding tomato and fried onion makes it delicious!
- Destruction of evil microorganism: Definitely you can eat raw pig meat (like our prehistoric ancestors), but you might swallow some tapeworms with it! If you cook in high temperature, it will be less risky.

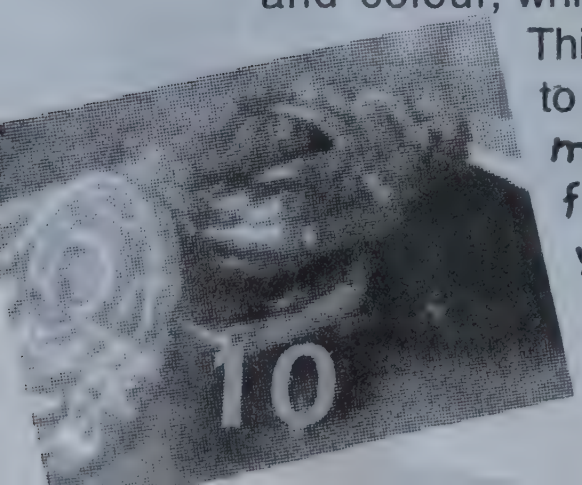


- Releasing micronutrients: It's said that having a raw egg in the morning will make you as strong as superman. But one important nutrient component of egg, 'biotin' is available only if you boil it. Same is applicable for other food.
- Increases variety: Try to remember the various functions which you have attended-birthday parties , picnics, weddings... definitely you have had different forms of rice like *pulav, biryani, khichdi, boiled rice, fried rice* etc. and chapatis, puri, paratha, momo etc made up of wheat flour. The different techniques in cooking increases the variety.

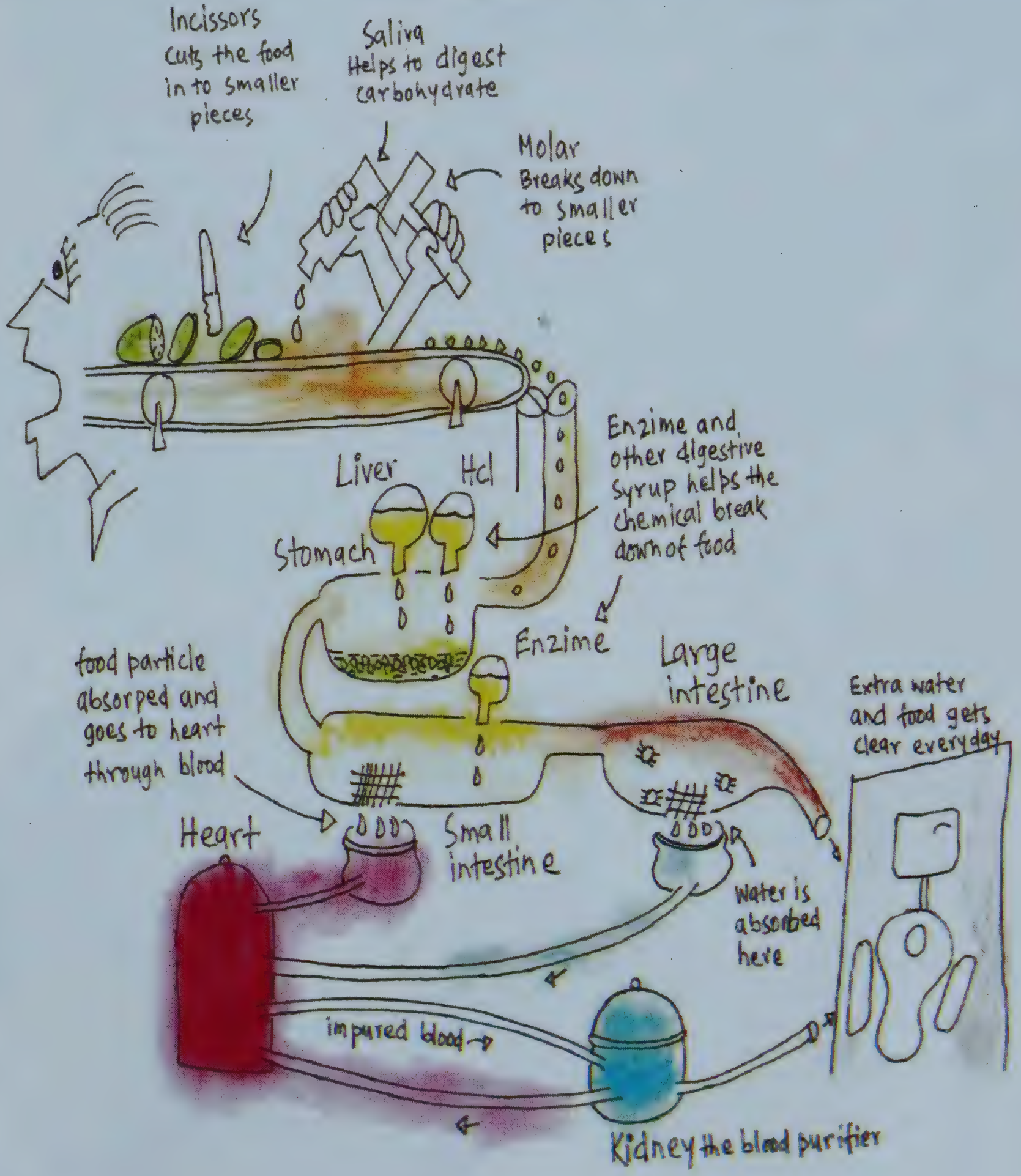


Food preparation has become an integral part of every culture! In cities we always have Chinese, Thai, Mexican restaurants and we insist that our parents take us to good restaurants. Thus food preparation is also a cultural phenomenon!

Not only that, food preparation is a science too! The study of food science involves an understanding of the changes that occur in the components during cooking. Many physical and chemical reactions occur, which helps in combining food ingredients in various ways with the flavours, textures and colour, which appeal to the senses. This understanding leads you to make a great cook. Your mother is possibly the best food scientist around you!

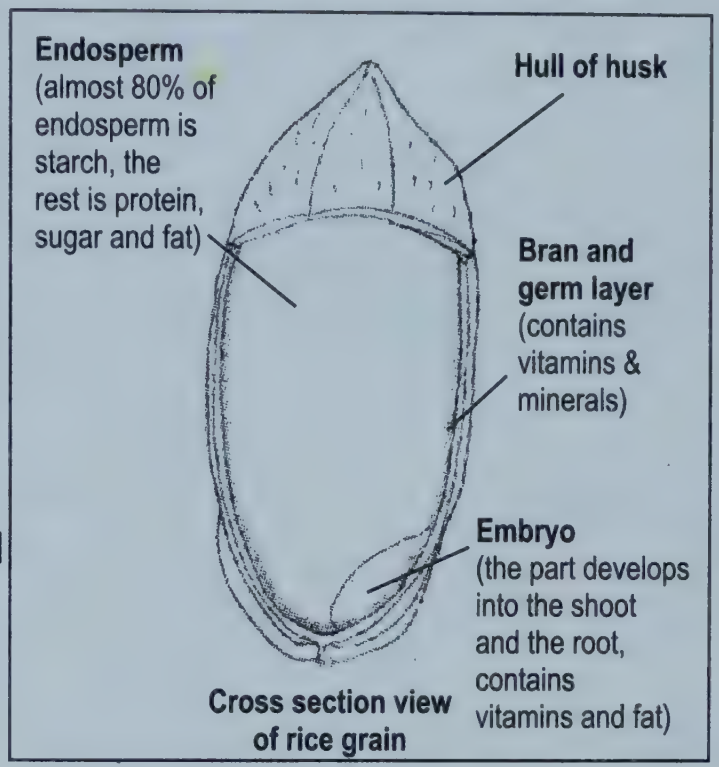


Here is schematic diagram of the digestive and allied systems. Can you locate where absorption and osmosis take place in your body?



What is the best time to add salt while you are cooking

It depends on what type of preparation we want. If we make soup, then we add salt before cooking. It will let the water and other substances flow out of the material. If we cook mutton curry, we will fry it first because we want the spices and oil to replace the water inside, so that it becomes tastier. We will add salt later on.


Endosperm
(almost 80% of endosperm is starch, the rest is protein, sugar and fat)
Hull of husk
Bran and germ layer
(contains vitamins & minerals)
Embryo
(the part develops into the shoot and the root, contains vitamins and fat)
Cross section view of rice grain

Tamarind and lemon, both are sour. Why do they have different effects on milk?

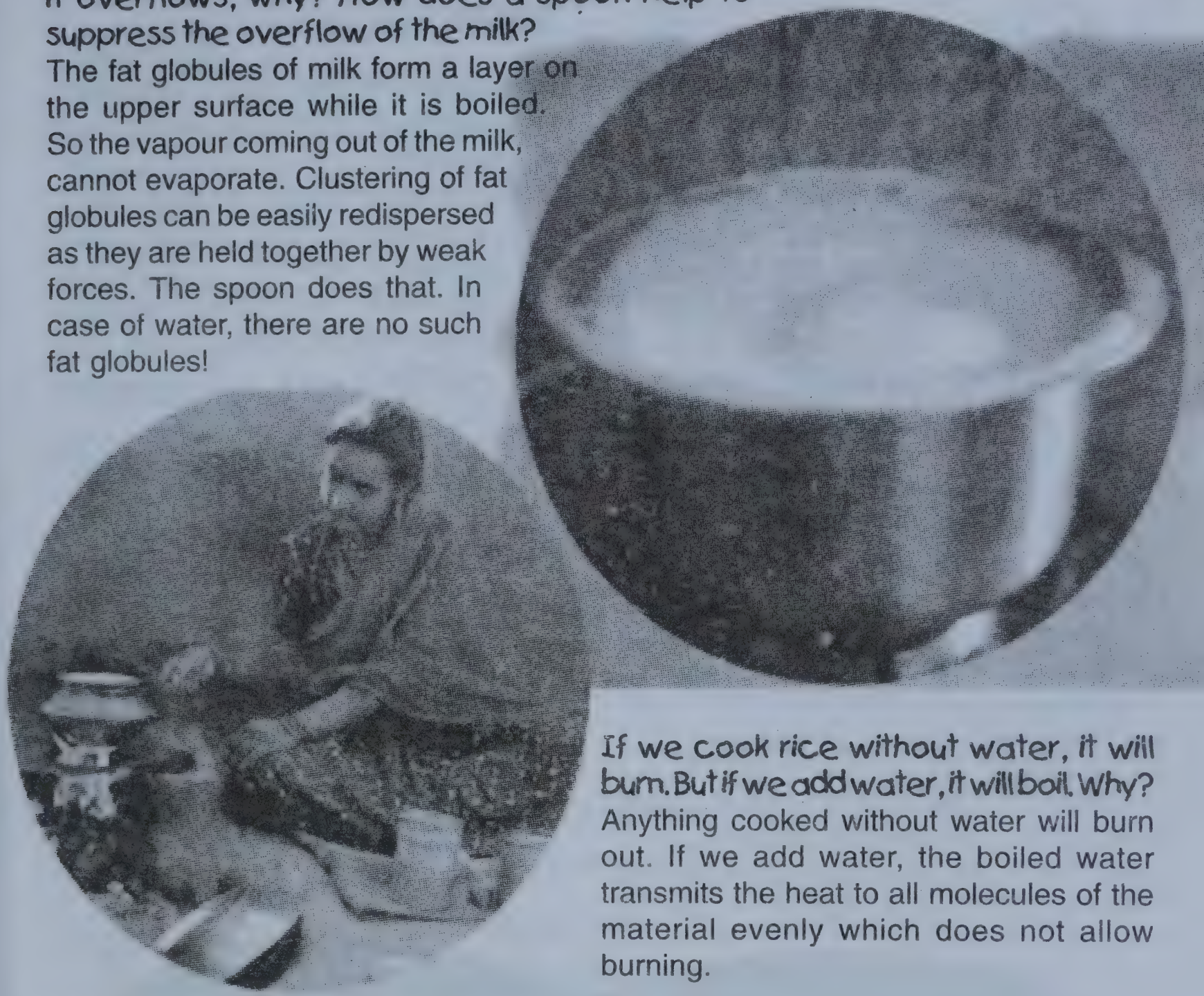
Effect of tamarind and lemon is not different. It is the temperature that matters! If we add tamarind/lemon when the temperature of milk is 30-40 degree centigrade, it will lower the pH value and create good atmosphere for lactobacillus bacteria, which transforms the milk to curd. But if we add tamarind/lemon when the milk is hot, it changes the structure of milk to create dispersed casein flakes.

Why brown rice has high demand? Why do we prefer rice that is kept for few months after harvesting?

You have observed that rice is covered with a brown coat, which is called the 'bran'. The bran has a high content of fibre and minerals. It is also a good source of thiamin and riboflavin (vitamins of the B-complex group). A layer called *aleurone* is located just under the bran, which is rich in protein, phosphorus, and thiamin, and fat. Although machine milling is time saving, that is, you get more rice milled in shorter duration than hand pounding, it removes all the above mentioned nutritious layers. This is the reason why 'brown rice' or hand-pounded rice has high demand and is costly too .

When we boil water it does not overflow from the pan but if we boil milk it overflows, why? How does a spoon help to suppress the overflow of the milk?

The fat globules of milk form a layer on the upper surface while it is boiled. So the vapour coming out of the milk, cannot evaporate. Clustering of fat globules can be easily redispersed as they are held together by weak forces. The spoon does that. In case of water, there are no such fat globules!



If we cook rice without water, it will burn. But if we add water, it will boil. Why?

Anything cooked without water will burn out. If we add water, the boiled water transmits the heat to all molecules of the material evenly which does not allow burning.

Is it good to feed infants with cows' milk to give strength?

This is a wrong concept. Cows milk is good for calves only, it is not meant for human infants. Mothers milk is the best for a baby, irrespective of species.

Dos

- Eat fresh leafy vegetables.. Buy locally available fruits and vegetables. It is fresh, cheap, tasty and nutritious than those that are available in the market.
- While peeling, peel out very thin layers, as vitamins and minerals exists just below the skin. Its better to cook potato, radish, carrot, beetroot with the skin. If you want, the skin could be peeled off after boiling
- Use little water while cooking. If water in the curry is in excess, don't throw away. Because the main nutrients are in the gravy.
- To save on nutrients , time and energy, cook vegetables in a covered pot.
- If possible, cook in an iron pot.

Don'ts

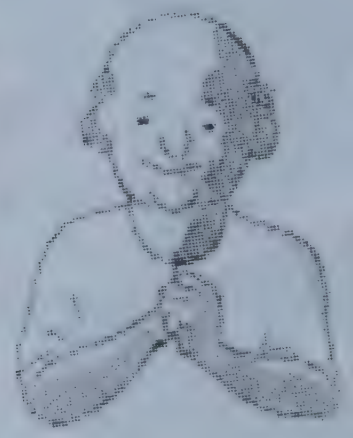
- Do not wash vegetables after cutting. It washes away the nutrients.
- Do not make small pieces of vegetable and do not chop vegetable long before you cook
- Do not throw away the bran water after you boil rice. It's very nutritious.
- Do not cook vegetables containing vitamin C
- Do not add soda while cooking, it will spoil the vitamins.
- Do not throw away beetroot, radish or carrot leaves. They are rich in minerals.
- Do not eat out-of-season vegetable. Most likely it will have more pesticide residues and less nutrient.
- Do not over cook. The more you cook, the more you lose on the nutrients.

Some more brainstorming for you

1. When we heat 'tava' and shake our wet fingers over the 'tava', the drops of water, which fall on it, dances. Why?
2. The lobster is dark bluish green in colour when taken from the water but changes red during cooking.Why?
3. Why tropical countries like India, Bangladesh, some African countries, Mexico have more spicy food than other cold climate countries?.

Munni was thrilled!!! One can learn so much from the kitchen? But we need to ask her mother whether Munni has changed her food habit.

But there was again a food class when Munni's grandparents came from the village. For dinner Ma prepared mixed vegetables, daal and chapaati. Grandma put one tea spoon full of Ghee in Munni's daal. Munni doesn't like ghee at all... but this time ahhhh.... what a great smell!! Ghee that papa buys from the market never smells or tastes like this!



"Munni, this is from the milk of my own cow 'Dhabali'. Dhabali eats only fresh green grass and straw from *desi* strain of rice. That is why her milk is tasty and so is the ghee ." Grandpa said.

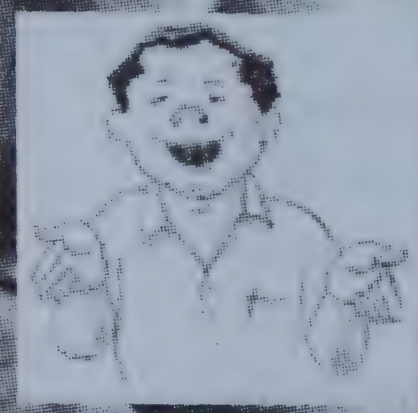
"But all cows eat the same thing. Even in the towns" - Munni argued.

"No, Munni, they do not. The cow keepers, who are commercially driven, always give certain hormone injections to the cows so that they give more milk. Also they give lots of artificial food to cows. These affect the quality of milk. And I don't need to mention that they add water too!!"

"That's true" supported Papa. "I still remember the taste and colour of the boiled eggs of deshi chicken we used to have before going to school. All these broiler chickens are so tasteless!!"

"Think about the vegetables. They look good , but are absolutely tasteless. And you will get

tasteless tomatoes or cauliflower all through the year. Just to think how eagerly we waited for the little fresh cauliflowers with the onset of winter...." Ma grumbled.

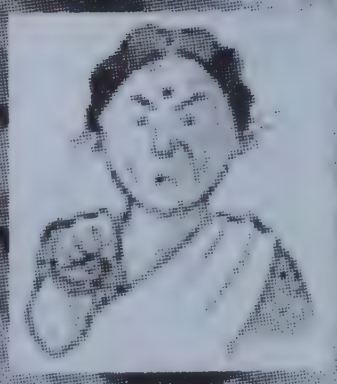


"But Papa, why is all these happening?" Munni was disturbed.

"That is a long story. Primarily because some farmers and food producers have become greedy. They want more products in less time. So there is a great demand for fresh looking, big sized vegetables which can be grown in no time. To meet this demand, scientists have developed new varieties of fish, bird, rice and vegetables. You have heard about 'hybrid' fruits and vegetables, haven't you?" replied Papa.

"But not all farmers think alike?"

"Of course not. The small farmers would rather grow the local variety because hybrid crops need more fertilizers and more water . It is very difficult for poor farmers to get all these. But what would they do? They have to compete with the big farmers who bring large amount of fresh 'looking' hybrid crops to the market and sell it at a lower cost."



"Surely we are to be blamed too. We always want a good-looking vegetable, milk-white rice and big fish. We don't care about the environmental cost and health factors related to hybrid food and the pesticide residues" - grandma finished off her daal.

'Yes, I know. Ma told me that [illegible] grown rice has all

nutrients intact" - Munni proudly said.

"Everybody adds extra colours, extra flavours to make food more attractive." Grandma said.

"All that glitters is not gold"- Papa said while washing his hands.

Munni was not very satisfied. She did not quite understand what are the things that are added to the food while cooking, besides salt, sugar and spices. She was stunned when Ma produced a long list before her.

The 'approved' additives

Colours and flavours, sweeteners and miscellaneous additives such as flavour enhancers, emulsifiers, anti-caking agents, antioxidants, glazing agents, preservatives, stabilisers...and the list goes on.

All natural or artificial additives must go through safety assessments and get approval from government. But studies show that even the approved additives cause health hazards. Here is a list –

Tartrazine (a yellow colourant used in cold drinks, sweets and sauces)- cause snettle rash, dermatitis and asthma.

Preservatives like sulphur dioxide, sulphites, benzoic acid and benzoates may trigger asthma attacks or worsen eczema.

Caffeine -linked to insomnia, birth defects and peptic ulcers

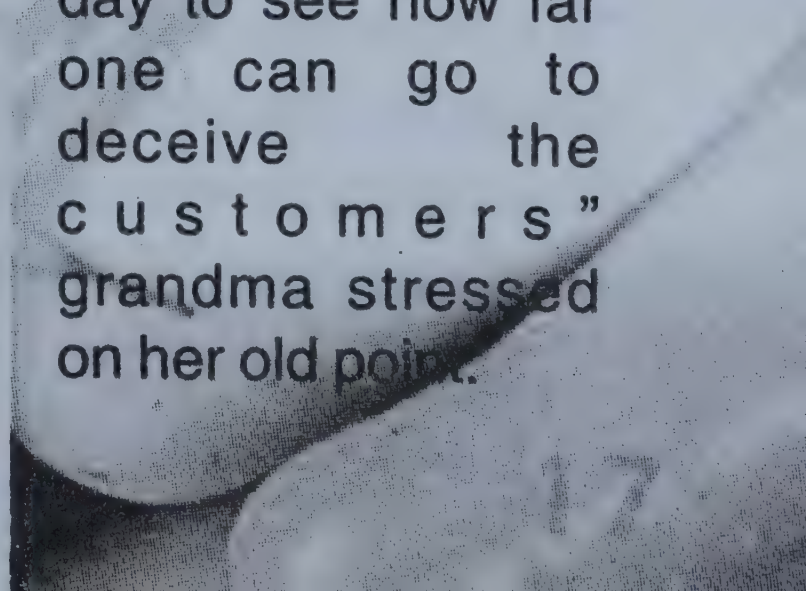
Monosodium glutamate -linked to headaches, tightness in chest, burning in forearms and back of the head

Nitrite and nitrate -can form cancer causing chemicals when heated

Saccharin -linked to cancer in laboratory animals.

"It seems only a matter of time before more 'approved' food additives will be deemed harmful by future research" – Ma commented.

"Why talk about just these additives which are mixed with the processed food You should visit Harish's store with your grandpa one day to see how far one can go to deceive the customers" grandma stressed on her old point.

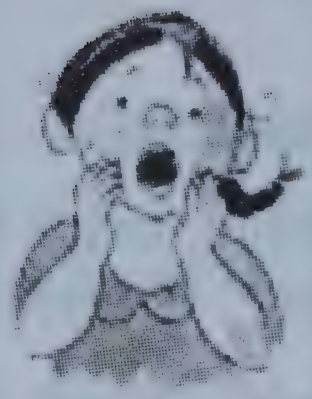


Intentional Adulteration

- Certain seeds of weeds with edible seeds like poppy seed, mastered etc.
- Iron dust and dried skin dust with tea.
- Non edible oil with edible oil
- Arrowroot, starch, soap solution in milk
- Chalk dust with sugar
- Papaya seed with pepper
- Tamarind seed dust with coffee
- Boiled potato paste with ghee

To make food look fresh and appetising

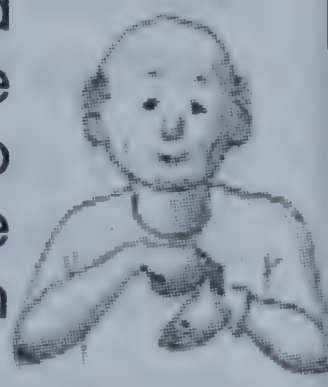
Note: See the simple experiments at the end of the book by which you can identify adulteration in food.



To increase weight with cheaper materials. Stone in rice, daal and other seeds

- Industrial red paint in fish
- Soil/brick dust with potato
- Copper sulphate in green vegetable
- Erythrosine in red sweet potato
- Colour in spices like chilly powder etc.
- Different kind of food colours in coloured food like laddoo etc.

Papa reacted strongly - "Good God!!I suppose I shall have to leave my job and buy a piece of land to produce my own food."



"Great idea" - grandpa cheered.

"But how can you be so sure that these things are adulterated?" asked Munni.

"Simple, even you can do that."

Munni was excited. She now wanted to know more. "Ma, then are there any 'unintentional adulterants'?"

"But of course. Ask your papa.He has recently written an article on this." Ma throws the ball to Papa's court.

"Contaminants-that's what they are called," said Papa.

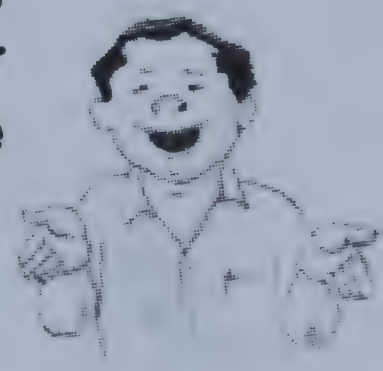
"Where do contaminants come from?"

A contaminant is a substance which is found in excess where it is not expected. Man makes some forms of contaminants, and some contaminants are found naturally in the environment. Many of these could cause harm depending on what these are, where these are found, and the quantity in which these are available.

Metals: You may hear these referred to as "heavy metals." They include things like mercury, cadmium and lead. High doses are toxic to most living things. These often comes through waste materials dumped in the ground.

Persistent Organic Pollutants (POPs) are manufactured chemicals. They are often a result of pesticides, industrial waste or burning of garbage.

"From anywhere" - Papa replied. "Pollution from one area of the world can easily travel to other areas. Many contaminants found in my village have never been used in the whole district!"



"But how do these reach our food?"

Bioaccumulation refers to how pollutants enter a food chain; **biomagnification** refers to the tendency of pollutants to concentrate as they move from one trophic level to the next.

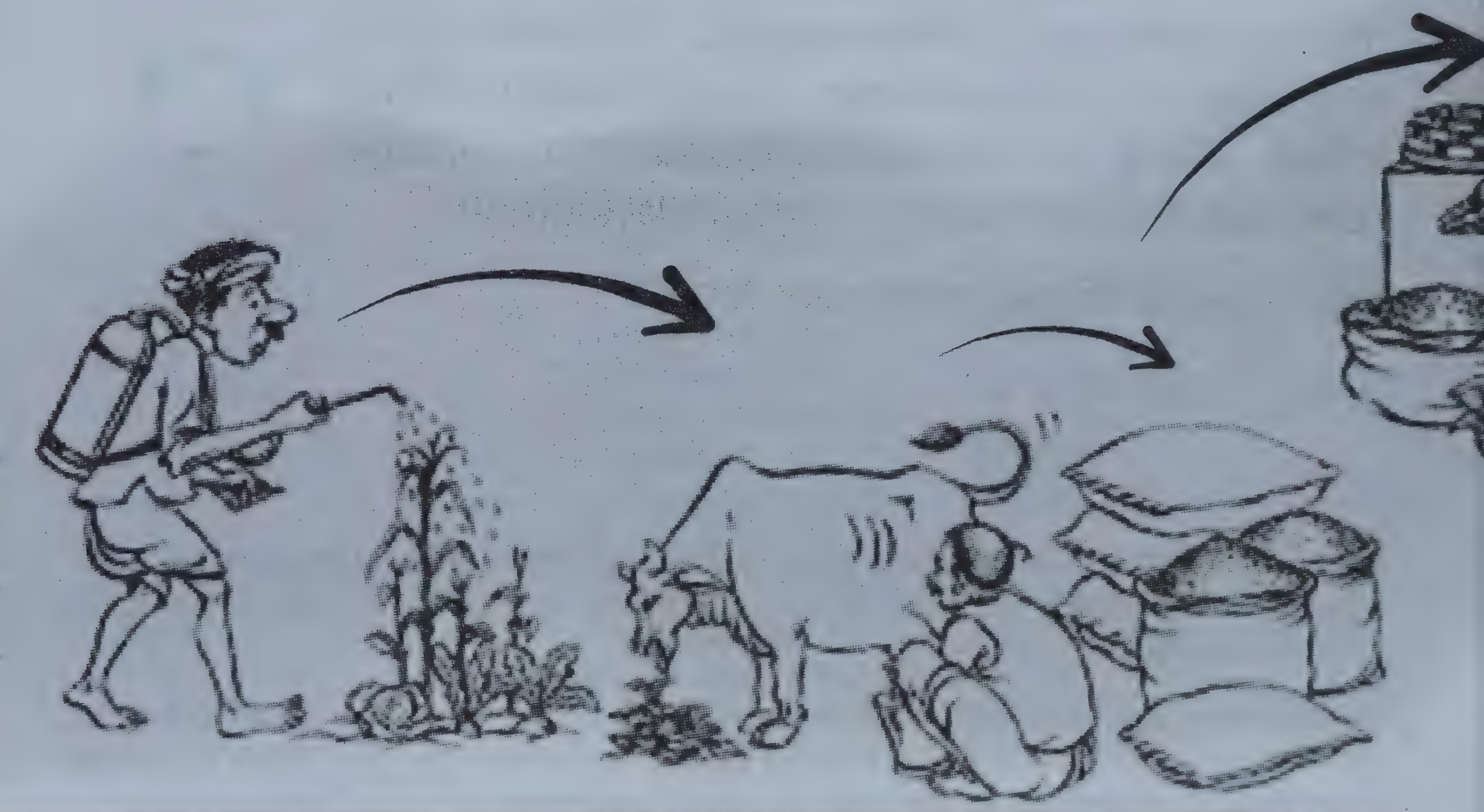
We are concerned about these phenomena because together they mean that even small concentrations of chemicals in the environment can find their way into organisms in high enough dosages to cause problems.

"Remember it was in the news recently that pesticidal residues were found in soft drinks. It is the same product that you had had last evening." Papa winked.

"Now, can you guess, what our future could be like? Ecologicaly it would devastate, kill or drive away all the friendly insects, pollinators, birds,and trees along with the harmful ones."

"What do you mean?" Munni gasped .

"Well, we will perhaps be able to drive away mosquitoes, but honey bees will be gone too. No honey bees, no



Classic example: DDT

DDT stands for dichloro, diphenyl trichloro ethane. It is a **chlorinated hydrocarbon**, a class of chemicals which often fit the characteristics necessary for biomagnification. DDT has a *half-life* of 15 years, which means if you use 100 kg of DDT, after 100 years, there will still be 800 grams of DDT in the environment. If it does bioaccumulate and biomagnify, much of the DDT will remain in the bodies of organisms.

pollination. No pollination, no food. No food....."

Grandpa quipped in, "not only that. It is entering the human body through food chains leading to slow poisoning." -

"Oh it's horrible. What can we do to prevent this?"

"At least we can take some measures which could help in reducing bioaccumulation indirectly. Choose products wisely, buy greener alternatives."

What you can do to avoid contaminants in food: List that Munni's Father provided

Do's

- Buy locally available fruits and vegetables. It is cheap, tasty and nutritious. As they are acquised locally, less energy is spent in the transport and less or no preservatives are required to keep them fresh.
- Treat vegetables with Potassium Permanganate / Sodium bicarbonate solution after buying from market.
- Go for small/medium local fishes.
- Dairy milk is better than milkman's milk.It is pure.
- Go for locally available edible weeds/leafy vegetable. They have medicinal value too.
- To avoid chemicals, its better to have local poultry breeds.
- Try to buy your vegetables from small venders, that might be their own garden's production.

Remember: Small and local farmers have less tendency to use pesticides and artificial fertilizers.We should be support them for our own sake.

Don'ts

- Do not eat out-of-season vegetables. Most likely it will have more pesticide residues and preservatives.
- Do not go for large fishes. The fish fat might contain pesticides or heavy metals.
- Do not go for fat and sumptuous looking vegetables. A 'not so good looking' one might be local and has less chemical.

Some more ... instorming

1. Why do w... ...t heavy food in the daytime but not early in th... ...orning?
2. Why the t... ... of water varies from one source to another?
3. Why is it ... advisable to have papads, smoked fish, mil... ...owder, pickles and jam during dehydrati...

Chapter 3 Food preservation

Munni's Grandma planned to extend her stay with them. It was almost the end of spring. Munni's Papa was narrating to Munni, how, as a kid, he used to steal pickles prepared by Grandma, and how tasty they were!

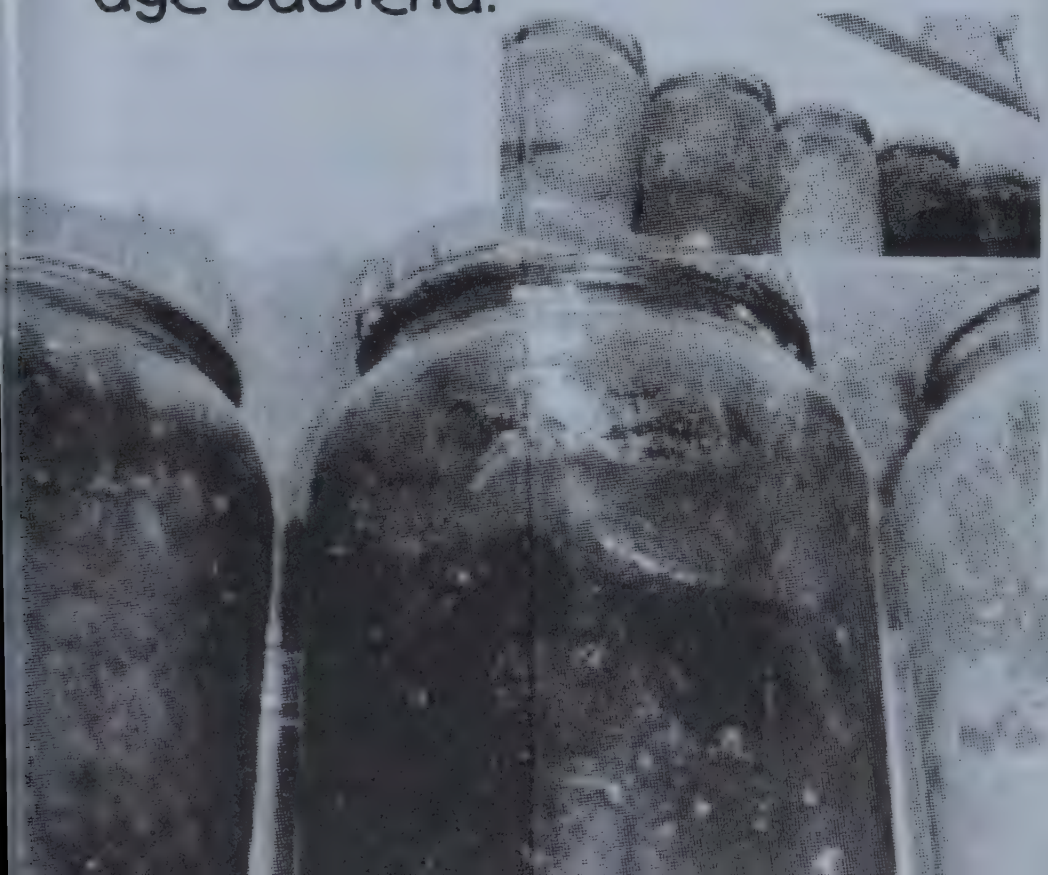
Next day, Munni heard Grandma giving Papa a long list of materials to be bought, which included green mangoes and lots of spices. Munni understood that grandma was about to prepare pickles.

"Dadi, how can you keep pickle for so long? Other food goes bad within a day, why not pickle?" Munni asked.

Grandma was grinding spices. "It is not a single chemical's work. There are multiple chemical reactions. Anything sour like vinegar or lemon has a preservative effect. Even sugar is used as a preservative. But do you know why food goes bad?"

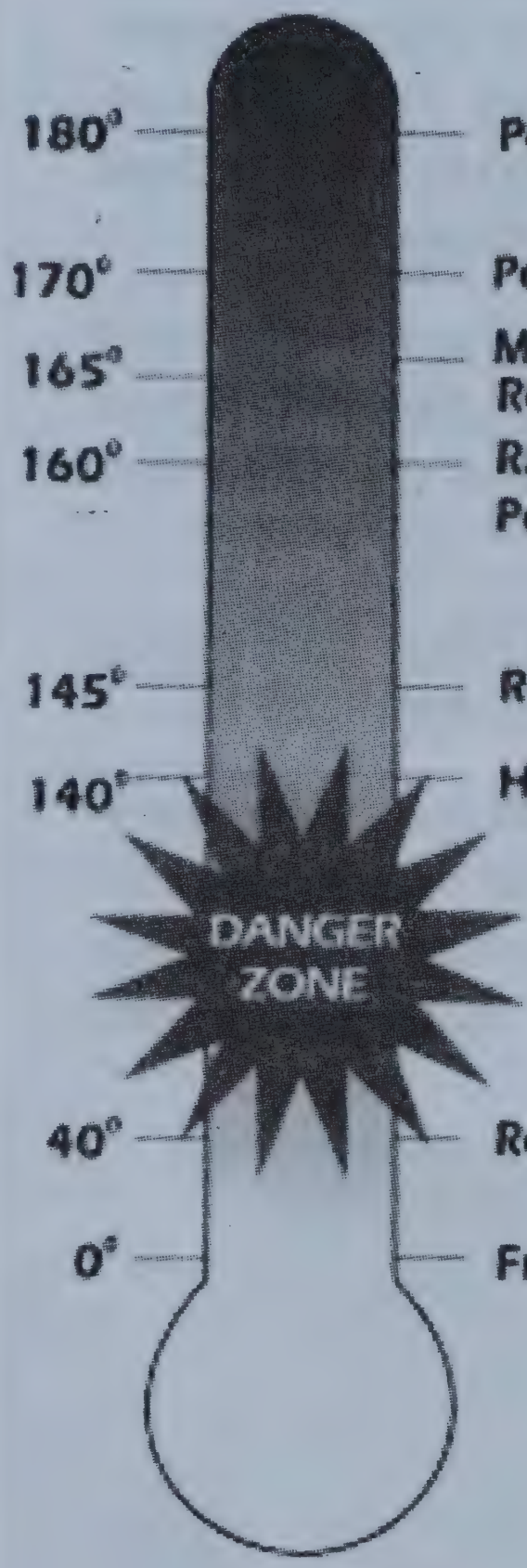
"Tell me why, dadi"

"That is basically because of spoilage bacteria."



What are spoilage bacteria?

Spoilage bacteria are *microorganisms*, too small to be seen without a *microscope*, that cause food to deteriorate and develop unpleasant odours, tastes, and textures. These one-celled microorganisms can cause fruits and vegetables to get mushy or slimy, or meat to develop a bad odour.



Danger Zone
The temperature range in which most bacteria can grow.

Food Safety Implication
Some bacteria can double their numbers within minutes and form toxins that cause illness within hours. That's why it's important to keep food below or above the temperatures at which bacteria can grow. Usually this is below 4°C (some pathogenic bacteria can grow at 0°C or above 60°C.)

Food Safety Precautions

- Cook food to safe internal temperatures (see the Safe Cooking Temperatures chart at left). Use a food thermometer to check.
- Keep hot food hot. Maintain the temperature of hot cooked food at 60°C or above.
- Reheat cooked food to 74° C. Never let the temperature fall below 60° C.
- Keep cold food cold. Store food in the refrigerator at 4° C or below or in the freezer at -18° C or below.
- Don't leave food out at room temperature for more than 2 hours.

Do all bacteria make people sick?

No, there are bacteria which are beneficial e.g. home made 'dahi' has 'S.lactis' which is beneficial. It is the Pathogenic bacteria which causes illness.
Age and physical condition place some persons at higher risk than others, no matter what type of bacteria is implicated. Very young children, pregnant women, the elderly and people with compromised immune systems are at greatest risk from any pathogen. Some people may become ill after ingesting only a few harmful bacteria; others may remain symptom free after ingesting thousands.

"Ok, I understand. But why can we keep pickle out for so long?"- Munni returned back to her question.

Well. What are the steps that are involved?

- If it is very sour, that means acidity is high, we add salt and sugar and keep it in the sun
- If it is not so sour, we need to add acid like vinegar or lemon etc and then keep it in the sun
- We can just sun dry after adding salt and keep it for long
- Sometime we fry and then keep it in the sun
- We put spices at the end.

So the law behind everything is

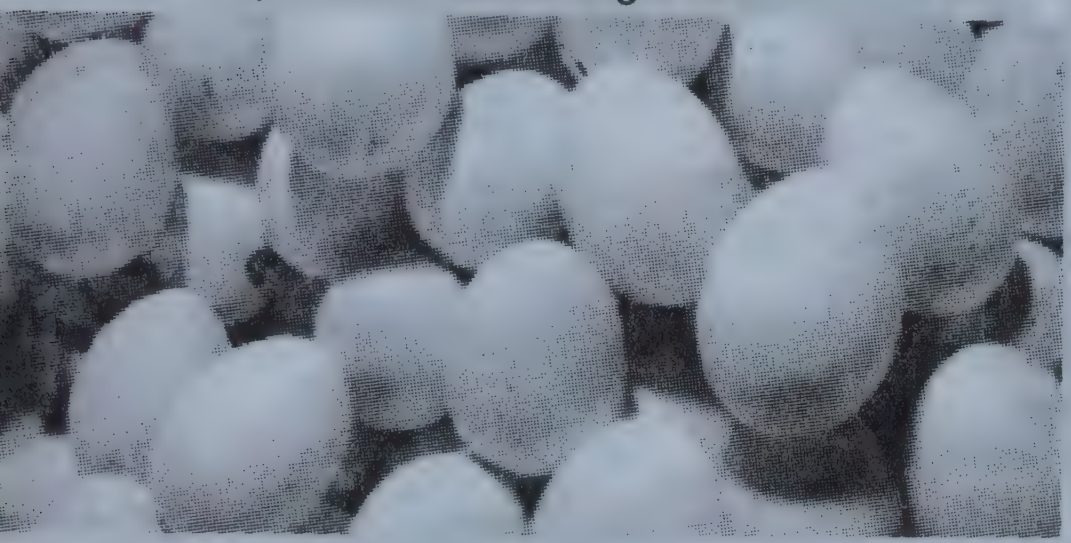
- The spoilage bacteria do not like highly acidic substances
- We drain out water from any material to make it long lasting-because the bacteria will not get the required water to grow.
- Sunrays disinfects. So we keep pickle (and other food substances) in sun to kill the germs/pathogens."

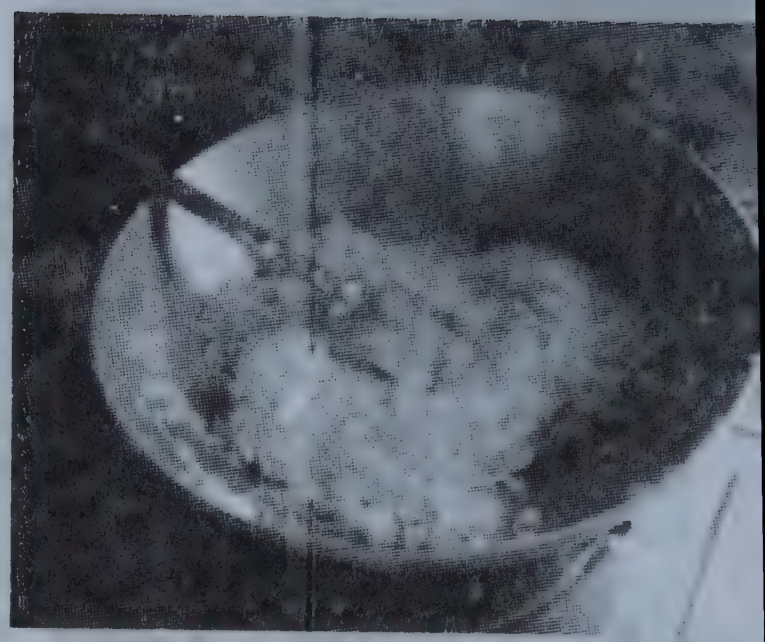
" W o w Grandma!! You are no less than a scientist! But even if we follow all these, we do get sick at times. Why is that?" Munni asked.

"Washing your hands properly before you eat, proper toilet habit, eating fresh food-these are the simple things one can follow to avoid illness. Especially in villages people must ensure proper sanitation." - grandma answered.

Is it safe to eat lightly cooked egg dishes and use recipes that call for raw eggs?

Unbroken fresh eggshells may contain certain bacteria that can cause food borne illness. Researchers say that if present, these can be usually in the yolk or "yellow." But they can't rule out the bacteria being in egg whites. So everyone is advised against eating raw or undercooked egg yolks, egg whites or products containing them.





Is it dangerous to eat raw or "rare" meat?

Yes. Raw meat may contain harmful bacteria. To ensure all bacteria are destroyed, cook meat loaf, meat balls, casseroles, and hamburgers thoroughly so that the meat turns brown in colour and reaches a core temperature of 75°C.

Is it safe to eat leftover food that was left and out then forgotten until morning? Will additional cooking kill the bacteria that may have grown? Is it okay to pour water in rice and keep it out overnight?

Bacteria exist everywhere in nature. They are in the soil, air, water, and in the food we eat. When they have nutrients (food), moisture, and favourable temperature, they grow rapidly, increasing in numbers to the point where some types of bacteria can cause illness. Some types will produce toxins that are not destroyed by cooking.

Pathogenic bacteria do not generally affect the taste, smell, or appearance of a food. In other words, one cannot tell that a food has been mishandled or is dangerous to eat. For example, food that has been left too long on the counter may be dangerous to eat, but could smell and look fine. If a food has been left in the "Danger Zone" for more than 2 hours, discard it, even though it may look and smell good. Never taste a food to see if it is spoiled.

So pouring water will not keep the rice away from bacteria.

Should a hot food be refrigerated hot?

Hot food can be placed directly in the refrigerator or it can be rapidly chilled in an ice or cold water bath before refrigerating. Cover foods to retain moisture and prevent them from picking up odors from other foods. Keep perishables in the refrigerator!

The cold temperatures keep most harmful bacteria from multiplying. A lot of people think putting hot food inside might damage their refrigerator, but it's not true. Hot food doesn't harm your refrigerator. More importantly, prompt refrigeration of food will keep your food and you safer.

On what principle does a Refrgerator work

In the summertime, have you ever got out of a swimming pool and then felt very cold standing in the sun? That's because the water on your skin is evaporating. The air carries off the water vapor, and with it some of the heat is being taken away from your skin! This is similar to what happens inside refrigerators. Instead of water, though, the refrigerators uses chemicals to do the cooling.

Do it yourself

Browning fruit

Have you ever set down a banana you were eating and come back to find it brown and unappetizing? The reason this occurs is that some fruits and vegetables contain colorless substances called **polyphenols** that turn brown when exposed to oxygen. The process is called **oxidation**. Let's see whether we can stop or slow this reaction.

You will need a banana, an apple, a potato. You will also need 2 tablespoons of granulated sugar, 2 tablespoons of lemon juice, 2 tablespoons of water, 4 paper plates, a knife, and a marking pen. Cut each fruit or vegetable into eight roughly equal pieces. Place two of each kind on each plate. Label the first plate "sugar" and quickly sprinkle the fruit and vegetables on the plate with the granulated sugar.

Label the next plate " lemon juice" and cover the fruit and vegetables with lemon juice. Repeat with the next plate, substituting water for the lemon juice. Leave the last plate alone and label it "plain".

Let the food sit uncovered at room temperature for thirty minutes. Think about what you expect will happen. Now look at the plates. Which food turned darkest? Which are closest to their starting color? Taste some (all are still safe to eat). Has the flavor changed?

What should have happened is that the lemon juice with vitamin C (an antioxidant) should have protected the fruit from browning. The sugar and water may have prevented some browning by acting as a barrier to the oxygen. The apple, banana, and potato on the plain plate should have turned brown.

Something more to argue with your mother

1. Is it necessary to refrigerate eggs?Should we wash eggs before keeping in the refrigerator?
2. Could we reuse the oil which has been left over?

Chapter 4 Fuel and Energy

Munni was feeling like a kitchen scientist. She never thought that one could learn so many things from the kitchen . Instead of 'kitchen' she started calling it a 'food laboratory'. Summer vacation had started. Munni was enjoying the pickles made by grandma. They have returned back to their village. Ma, Papa and Munni will also go to their these village soon.

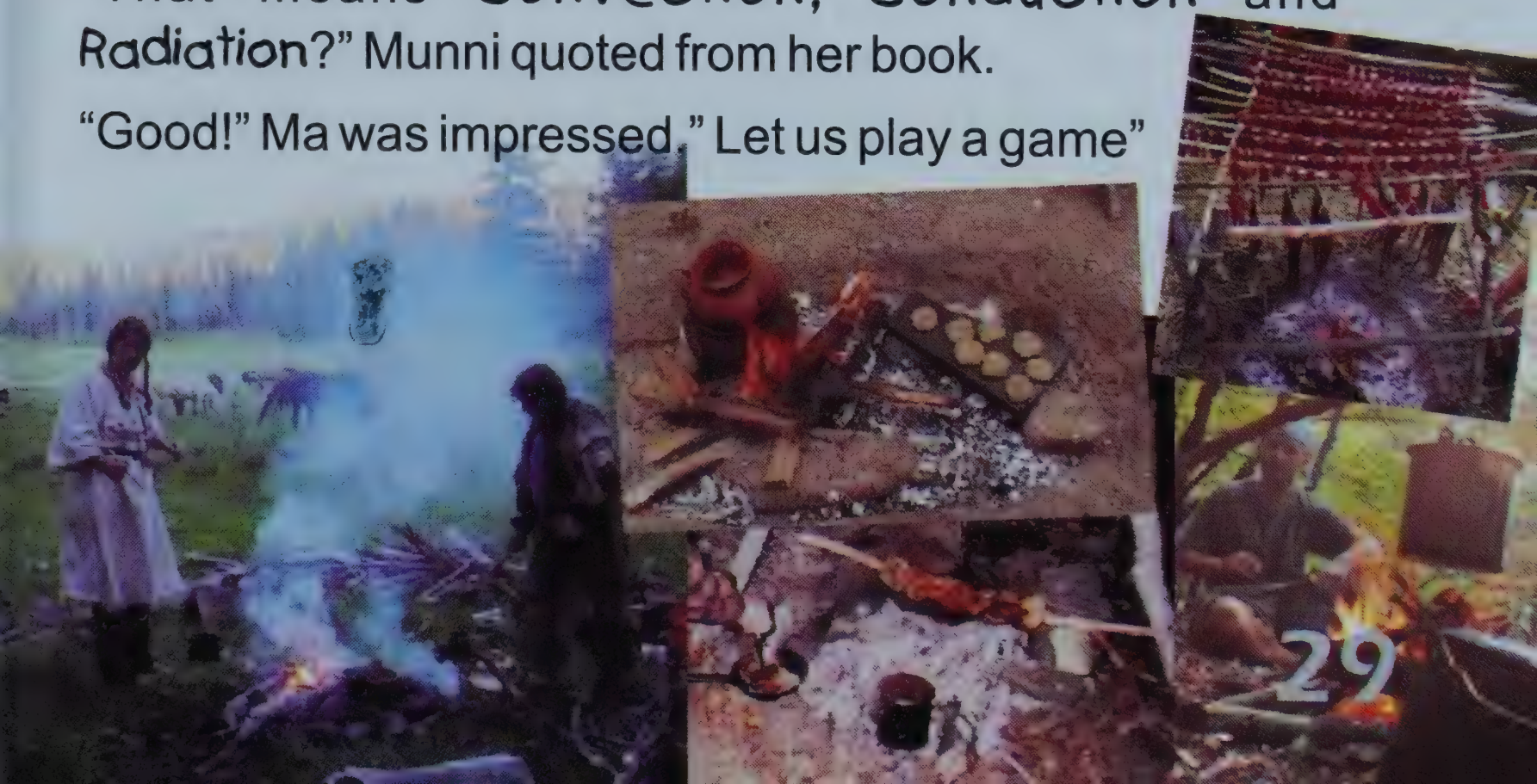
That day, Munni was helping out her Ma. She became very inquisitive now, asking questions every now and then. Ma tried to answer patiently. Munni noticed that there were so many types of cooking Ma does everyday- boiling, roasting, frying, deep frying .. so many!

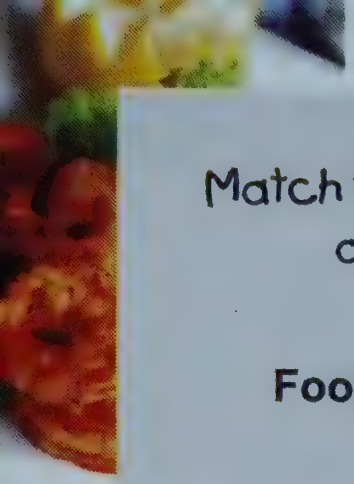
"Why so many types of cooking, Ma?"

"At the dawn of civilization, man used to have raw food, using the energy in the form of chemicals stored in the food. Incidentally, they discovered that roasting makes food tasty! Gradually other types of cooking evolved. While cooking, we are basically using three types of heat transmission."

"That means Convection, Conduction and Radiation?" Munni quoted from her book.

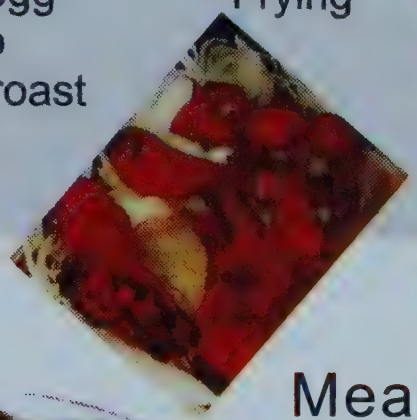
"Good!" Ma was impressed." Let us play a game"





Match the following food, cooking processes and heat transmission processes

Food	Cooking Method	Heat transmission method
Chaapaati	Boiling	Conduction
Cake	Roasting	Convection
Toast	Toasting	Radiation
Boiled egg	Frying	
Soup		
Chicken roast		
Idli		



"Another thing I have noticed Ma. You have different types of cooking utensils too!"

"You can find out the reason on your own. For deep-frying I use a pan. Why? Deep-frying Means I want to evaporate the water inside. So I need a pan, which has a wide space."

"For boiling rice, you need a covered utensil to retain the heat inside."

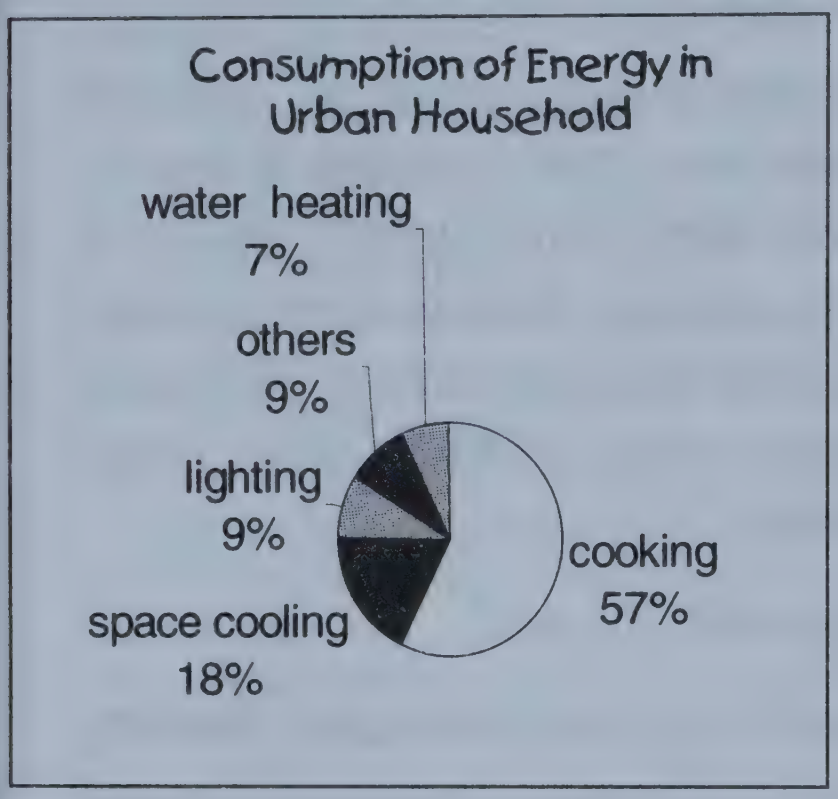
"Very good. This varies from place to place, region to region. The material also varies."

"Here is also an energy correlation"- papa walked into the kitchen with a huge bag of vegetable and groceries. "Energy as a whole is a major environmental issue today."

Earth has a vast array of energy sources, the fossil fuel beneath the surface, the wind and water on its surface, the plants growing on it, the sunlight falling upon it. In fact the ultimate source of all energy is sunlight. Fossil fuel is decayed remains of ancient plants and other organisms which have turned into coal, oil and natural gas through the action of heat and pressure. Earth had stored its non renewable mineral resources over a long period of time, which we have almost exhausted in our hurry. It would take a l-o-n-g time to substitute the loss. What shall we do meanwhile?

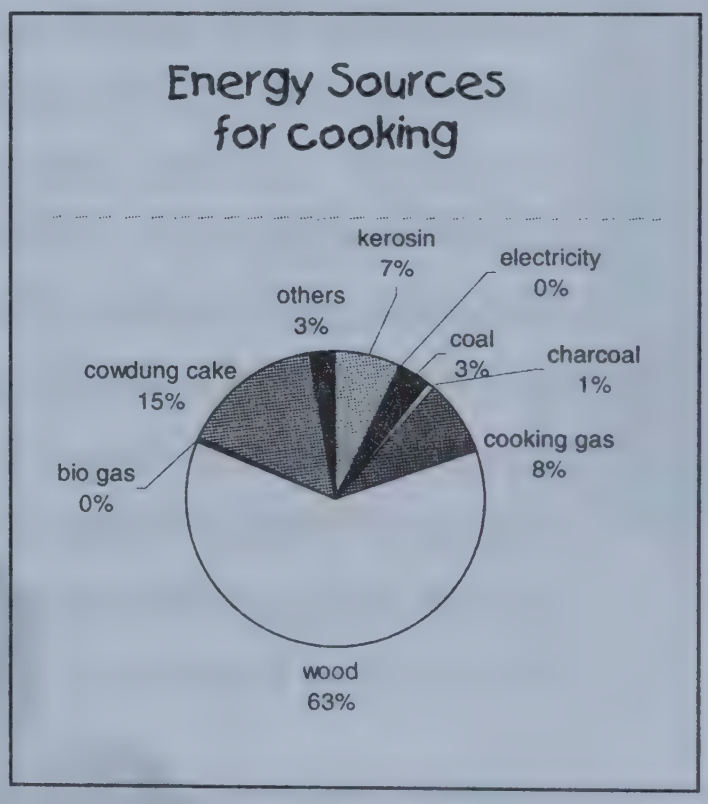
"Why don't you wash and sit at the table. Breakfast is ready."

Papa continued as Ma served them hot Uttapam.

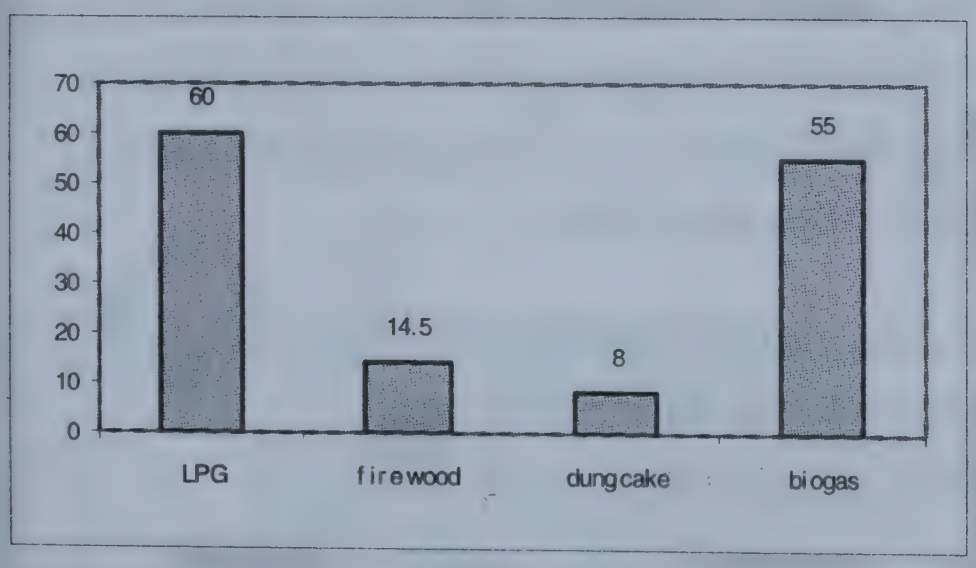


"An urban household like us consumes most of the energy in cooking. This is evident from the pie diagram"

"And for cooking, people use several things. Here is another pie diagram describing the materials."



"Efficiency of these things also varies a lot" - Papa explained.



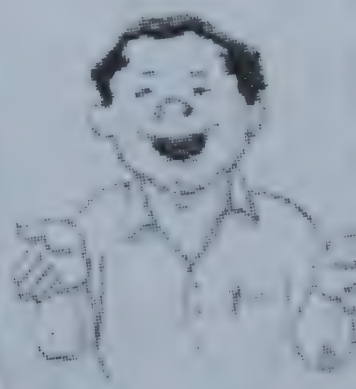
Efficiency of cooking materials

"What is efficiency Papa?" Munni did not understand.

"Efficiency means getting the greatest possible amount of output with the least amount of input - effort and cost. People in villages mostly use inefficient energy sources. You will feel sorry to see how women struggle to make a fire for cooking. Some use coal and dung cake which would fill their room and kitchen with smoke. Some cannot even afford to buy coal. They use cow dung cake and fire wood. Sometimes women and even small children walk miles to collects twigs and branches."

"Can't we do anything to check it Papa?"

"Yes, by increasing fuel wood production and thereby increasing the existing supply of firewood, we could make a difference.. Different types of fire wood have different property. Some produce less smoke, some produce more heat, duration of burning is more for others etc. People can make a list of all the possible weed that can be used as firewood, and the wood ash could be used in garden and for other purposes. They could try collecting seeds of these trees and plant them in fallow lands which would reduce the energy and time for fuel gathering and loss of soil health of the fallow land too"



"The mismanaged methods of using firewood, fuel and utensils also decrease efficiency as a whole. So some other measures can be taken up also."

One-fourth of humanity suffers fuel scarcities. Half of the world cooks with wood. Accelerating wood shortages in many countries add new burdens to families, particularly in third world countries. Some serious facts-

- Rural women of all ages in many countries - including those who are pregnant and have infants, the elderly, and very young girls who should be in school - spend a lot of time and walk long distances to find, then carry, heavy loads of wood.
- Urban families in many developing countries now spend up to a third of their income for cooking fuel.
- Refugees in Kenya often barter away part of their food rations to get fuel to cook the remainder.
- Many families are unable to cook nutritious foods such as beans and maize, which require hours of cooking, and substitute with less nutritious, fast food such as pasta.
- Families are also less able to heat/pasteurize their water and milk to reduce water borne-diseases, the major killers of children
- Fuel-gathering is one factor in the tide of migration to cities. A rural Zimbabwean summed up the possibilities: "Today many young Zimbabwe women don't want to stay in rural areas because gathering fuel wood is so difficult and time-consuming."

Papa gave some suggestions.

- proper choice of firewood
- efficient generation of heat, so that you get the most of it
- efficient transmission of heat, to avoid loss
- retention of heat and minimisation of heat loss

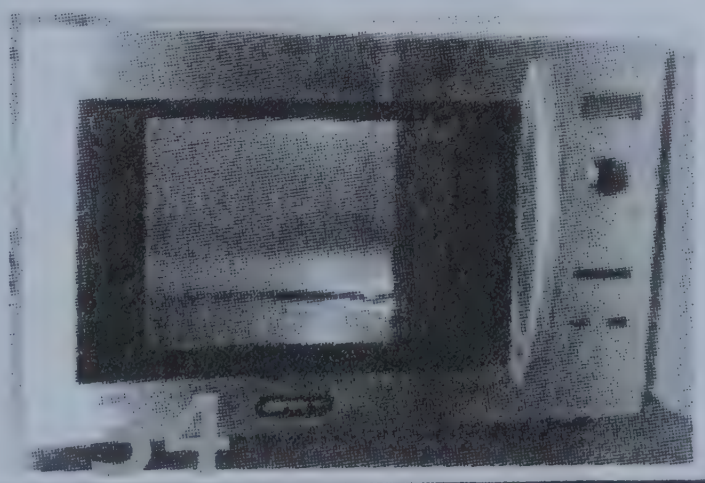
Ma also suggested a few."And obviously do not forget about cooking methods. I will give you a list Munni, which I learnt from my Mother"

The wise Cook

- Keep the vessel covered with a lid during cooking - it keeps the heat in and helps cook faster.
- Do not cook continuously on a high flame. When the liquid in the food starts boiling, the flame size can be reduced. This habit can save 40% fuel.
- A pressure cooker can save 75% of the fuel.
- Turn off the stove few minutes before the cooking is finished and keep the vessel covered to save fuel.
- Plan and keep things ready before the stove is turned on, to reduce fuel wastage. Get the family to eat together - it saves having to reheat food several times.
- Ensure that the bottom of the cooking vessel is large enough to entirely cover the burner
- Maintain the stove - ensure that the holes are not clogged, wicks are trimmed, etc.
- Use a solar cooker and spend less on cooking fuel

How does a micro oven works?

Microwave oven produces a radio wave, that is being absorbed by the water molecule inside the food. As a result of this energy gain, water particle starts vibrating very fast. This vibration causes generation of heat which heats up the food from inside.



Do it yourself

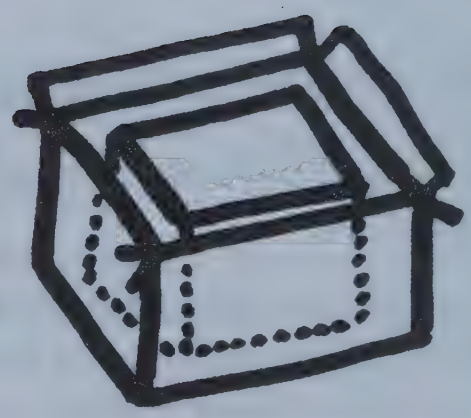
Solar Cooker

Sunlight is being used by people directly to heat water and cook food. Solar cooking can help to alleviate many of the problems faced by poor families around the world.

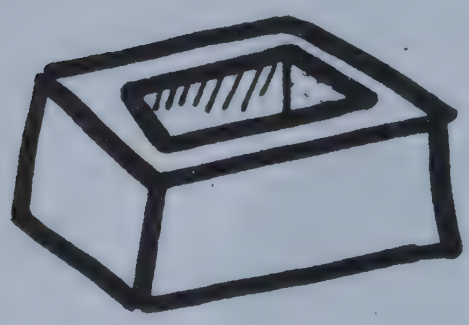
What You Will Need

- Two cardboard boxes, one fits inside another with a small distance between the two.
- One sheet of cardboard to make the lid. This piece must be approximately the same size as the top of the outer box.
- One small roll of aluminum foil.
- One can of flat-black spray paint or one small jar of black tempera paint.
- Some glue.
- One/two sheets of glass.

Building the Base

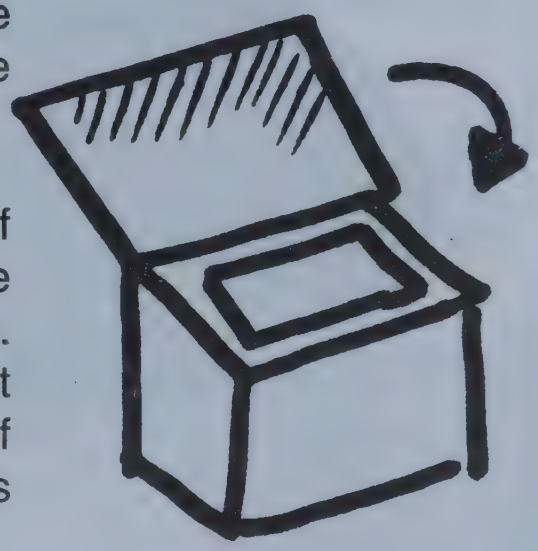


Fold the top flaps closed on the outer box and set the inner box on top and trace a line around it onto the top of the outer box, Remove the inner box and cut along this line to form a hole in the top of the outer box.



Glue aluminum foil to the inside of the inner box and also to the inside of the remaining top flaps of the outer box.

Place some wads of crumpled newspaper into the outer box so that when you set the inner box down inside the hole in the outer box, the flaps on the inner box just touch the top of the outer box.



Finally, to make the drip pan, cut a piece of cardboard, the same size as the bottom of the interior of the oven and apply foil to one side. Paint this foiled side black and allow it to dry. Put this in the oven so that it rests on the bottom of the inner box (black side up), and place your pots on it when cooking. The base is now finished.

Building the Removable Lid

Take the large sheet of cardboard and lay it on top of the base. Trace its outline and then cut and fold down the edges to form a lip. Glue a piece of aluminium foil on it.Paste it with the body. Use a stick to orient it to allow maximum amount of light to enter inside the cooker.

You can place a piece of glass as big as the top of the cooker. You can place another piece on top of it, but little bit elevated by some pieces of wood, to improve the efficiency.

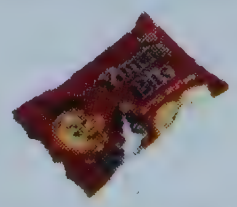
Happy cooking!!

The principle of solar cooker

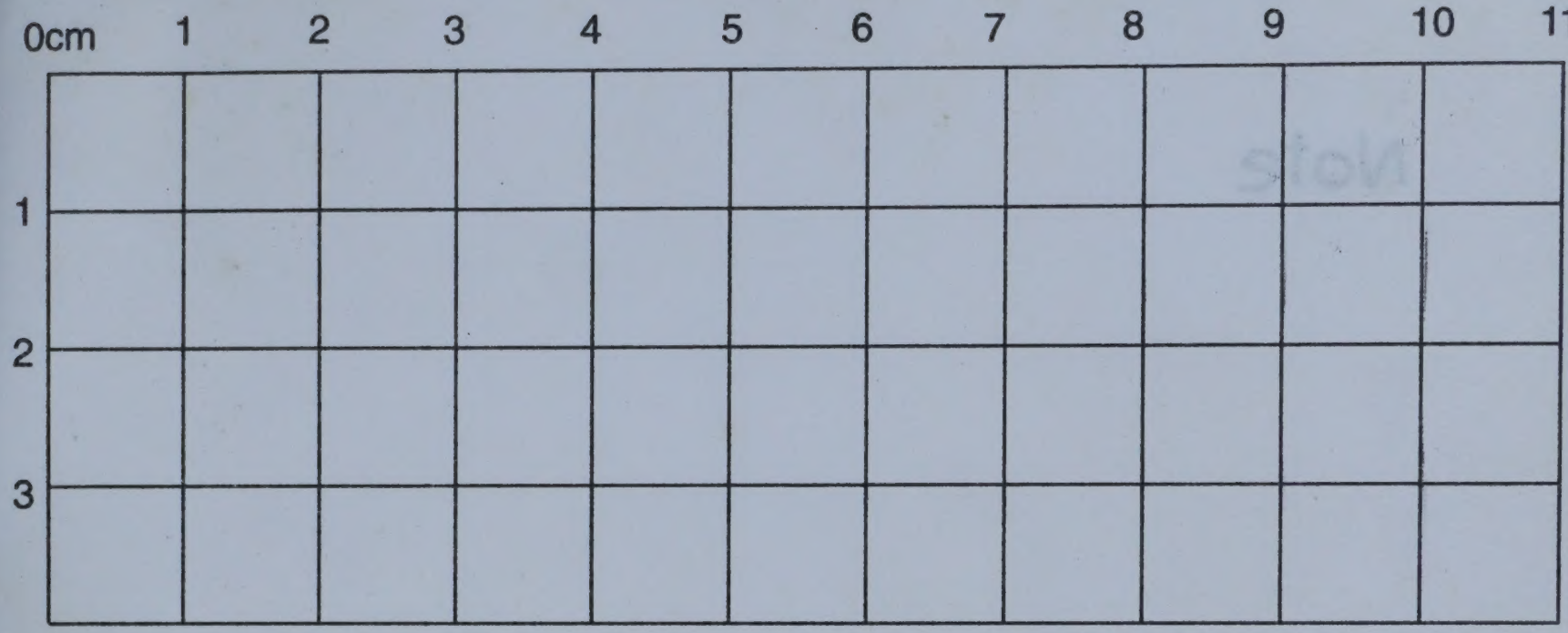
The basic purpose of solar box cooker is to heat things up - cook food, purify water etc.

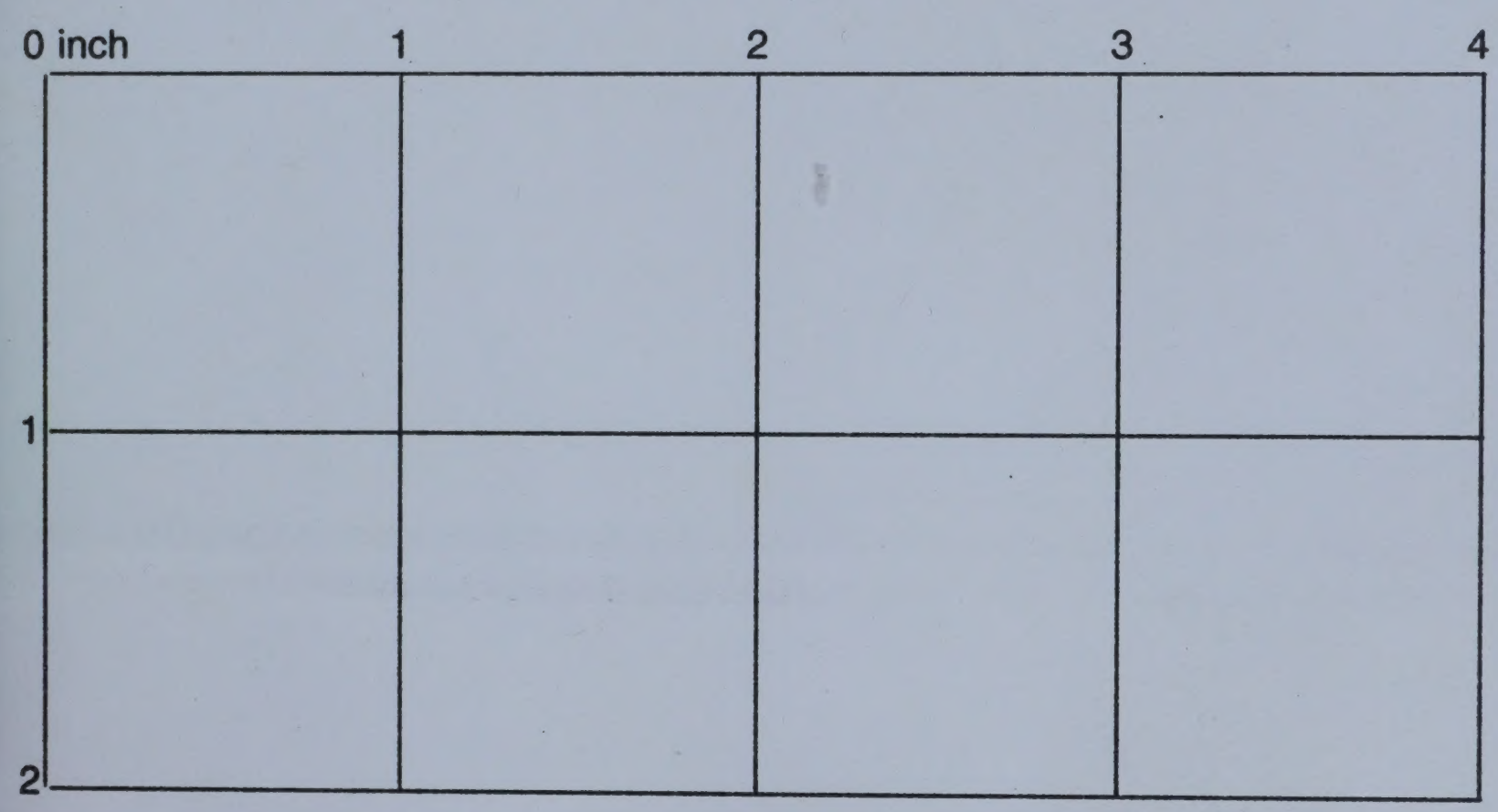
A solar box cooks because the interior of the box is heated by the energy of the sunlight entering in to the box, direct and reflected, through the glass. It turns to heat energy when absorbed by the dark absorber plate and cooking pots. The heat cannot pass back through the glass. This gives a kind of greenhouse effect. You can increase the efficiency of the cooker by trapping maximum amount of light by following the models given here.

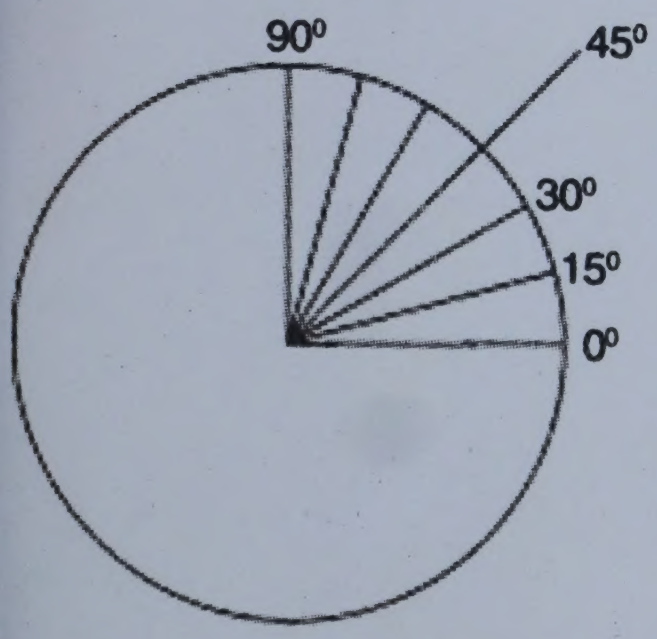
Can you think of another box, which has heat insulated walls to keep food warm for longer time? Even this can cook a half-cook food for you!!

Food	Adulterated Material	Process of Identification	Health Effetct
- Yellow coloured sweet - Yellow coloured pulses dust -Turmeric powder	Metanil Yellow	Add few drops of Muratic acid or Hcl. If it turns redish/purple, metanil yellow is present in the substance	Kidney and lung related disorder, breast tumer etc
Jam. jelly Sauce, logense etc, red coloured food	Congo Red 	Make a solution of the food. Add HCl. If Congo Red is there, it will turn Blue.	Ulcer in brain, eye
	Rodamin	Make a solution of the food. Add Carbon Tetrachloride. If Rodamin B is there, The red colour will vanish.	Ulcer in lever
Green Vegetable and peas	Malachite Green	Wet some cotton in liquid parafin and rub the vegetables. If the cotton turns green - you will understand Malachite green is there.	Trouble related to testis, spleen, kidney lever etc. Tumer in breast and ovary.
Milk	Water, Arrowroot, Starch	If you test milk in lactometer, and the reading shows less than 26, water has been added. Add few drops of iodine in the milk. If it turns blue - you will be sure that there is starch/arrowroot.	

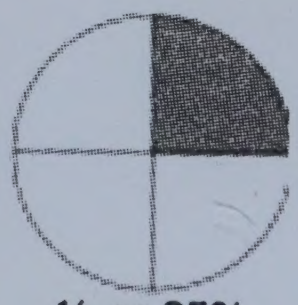
Food	Adulterated Material	Process of Identification	Health Effect
Puffed rice	Urea- to make the puffed rice whiter	Make a solution in water by soaking the puffed rice for 10 minuets. Add a spoon full of pegion pea dust, keep for 5 minutes, add penapthhalene. If the solution turns pink, urea is present.	Cancer and kidney trouble
Tea	Colour, iron	Tea will show its colour only when it is mixed with hot water. Tea solution in cold water will ensure prsence of other coloured substances. Use magnet to separet iron dust.	Stomach problem
Sugar	Chalk, dust, flour	Make a solution in water. The insoluble part is the adulterated material.	Stomach problem



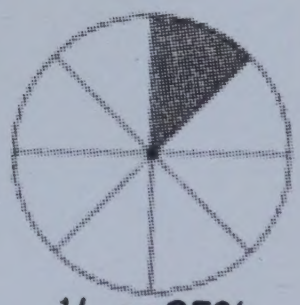




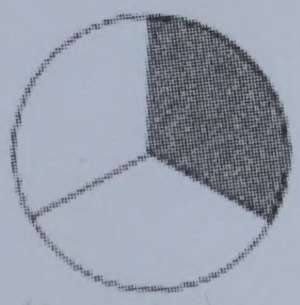
½ or 50%



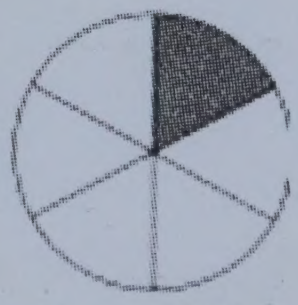
¼ or 25%



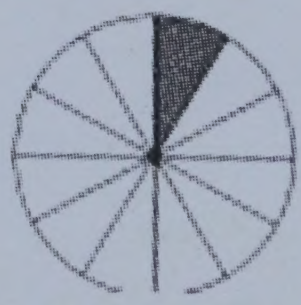
$^1/_8$ or 25%



$^1/_3$ or 33.33%



$^1/_6$ or 16.66%



$^1/_{12}$ or 8.33%

Note

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